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Design standards for safety warning messages in manuals: increasing design saliency and adapting for a broader range of professional communication settings

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**Design standards for safety warning messages in manuals: increasing design saliency
and adapting for a broader range of professional communication settings**

by

Rachel Elizabeth Roe

A thesis submitted to the graduate faculty

in partial fulfillment of the requirements for the degree of

MASTER OF ARTS

Major: Rhetoric, Composition, and Professional Communication

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Abstract

Safety warning messages in owner's manuals act as the visible and text based warning to users to avoid potential harm or injury. These warnings include those for DANGER, WARNING, and CAUTION. Current existing standards and general design principles give recommendations to safety warning message design, but they do not discuss the implications of adapting these recommendations to a broader range of professional communication settings.

This thesis focuses on analyzing the salience of safety warning messages in owner's manuals, and ultimately creating a set of safety warning message design criteria that will be adaptable to a broader range of professional communication settings. This thesis uses two methods to examine the ways in which these warning messages are salient. The first is a literature review of current safety warning message design standards and general design principles. The second is an analysis safety warning messages from a representative sample of owner's manuals for a high-powered, high-risk product.

The results of this study suggest the design features that make safety warning messages salient in owner's manuals. The results further open future discussions of analyzing design criteria and how to create design criteria that can be adaptable to broader professional communication situations.

Chapter 1: Safety warning messages

Safety warning messages in product manuals, despite their obvious importance for user safety, participate in some design issues common to the owner's manual genre. Owner's manuals are most often the first and only communication between the product's manufacturer and user. According to George A. Peters and Barbara J. Peters in *Warnings, Instructions, and Technical Communications*, manuals "explain and detail the procedures for proper operation and care of equipment" for owners of new products (58) and are the "direct means of communicating safety-related information" to the user (95). However, according to William J. Vigilante and Michael S. Wogalter in "On the Prioritization of Safety Warnings in Product Manuals," manuals are frequently difficult to read and comprehend because they fail to highlight important information to capture users' attention (278). Vigilante and Wogalter observe that the objective of a manual is education and awareness raising and that users generally only use manuals when they have questions about products. Owner's manuals do not only provide instructions for operation and maintenance for products; they also communicate potential hazards to users.

To a technical writer, what specifically is a safety warning message? For the purpose of this thesis, it is defined as a warning message in owner's manuals that typically consists of a signal word, safety alert symbol, and text. Safety warning messages in manuals act as reasonable attempts to provide risk information and an opportunity to avoid personal harm (Peters and Peters 4). Later as we discuss design standards for safety warning messages, their three-part structure—signal word, safety alert symbol, and signal word panel—will provide a useful scheme for analysis.

Creating safety warning message design criteria

During the summers of 2008 and 2009, I had the opportunity to write, study, and analyze

owner's manuals written for a small outdoor power equipment manufacturer, discerning in the process notable discrepancies in the design of safety warning messages. Expanding my research to focus on these inconsistencies, I discovered a problem. A glance through almost any set of owner's manuals shows that, in terms of design, safety warning messages are needlessly varied and confusing. For the current study, I reviewed safety warning messages in chainsaw manuals, specifically those from Craftsman, Poulan, Echo, and Makita. During my review I had a problem just trying to locate the warnings within the manual and to decide which warnings I should take more seriously. Did the warning's bold type indicate a more serious hazard than the one using a run-on header? My review observes that within each manual the safety warning message design is based on different design theory and techniques. How can we reconcile such divergent products? As a first step to better understanding this problem and identifying a solution, I conducted a literature review of design theory and practice. Safety warning messages play a crucial role in maintaining the safety of users, and therefore, attention to their design is critical.

As reported by Hans van der Meij and Mark Gellevij in *IEEE Transactions on Professional Communication*, warnings inform users about hazards they may encounter as they operate and maintain products (10). A few guidelines have been established by the American National Standards Institute (ANSI) that help technical writers become aware of designing messages. However, these guidelines are only one way to design such messages because they are limited to specific types of warning messages for specific settings. Other guidelines come from general design principles such as the benefits of using symbols and color and optimum text size for various reading environments. Unfortunately, current information on designing warning messages does not allow for design criteria that can be adapted to a broader range of professional communication settings. To address this problem the safety design standards I develop in this

thesis could serve as the beginning for new discussions of standards. As a specific and representative case, my thesis studies the way safety warning messages are presented in owner's manuals for high-powered, high-risk products in this case the gas-powered chainsaw working ultimately toward creating a set of criteria for safety warning messages that can be used in a broad range of professional communication settings.

Understanding the problem of varied warning messages requires background both in the design theory and in the implications of message placement within manuals. To build this background, I will first describe the design elements that are a part of standard theory on document design. Then, I will discuss the implications of safety warning message placement within manuals and sets of task instructions. Based on these areas, I will propose a set of working criteria for the design of safety warning messages, a set applicable for a broad range of professional settings.

Studying the design of safety warning messages

In this thesis I seek to answer the following research question:

If a set of safety warning message design standards were to be developed based on current best practices in typography, layout, emphasis (color and borders), use of signal symbols, and placement within manuals, what would the major design criteria be, and how might they serve as a catalyst for new standards discussion?

To address this question, I will analyze the design of safety warning messages in four gas-powered chainsaw owner's manuals—those manufactured by Echo, Incorporated, Poulan, Makita, and Craftsman. As a starting point, I will look at the manuals themselves and conduct a rhetorical analysis to identify which elements of design were used. Then, I will compare the designs to each other and to the design standard practices found in the literature review. From

these analyses, I will create a set of criteria potentially adaptable to a broad range of communication settings by technical communicators designing safety warning messages. My discussion of the problem; review of the literature; explanation of methodology; analysis and implications; and final recommendations are separated into five chapters.

Chapter 1: Safety warning messages

I begin the study with a description of the role owner's manuals play when users purchase a new product. I then describe the role safety warning messages play in owner's manuals as an attempt by the manufacturer to provide potential risk information regarding the product's use and an opportunity for the user to avoid personal harm.

Chapter 2: Elements of safety warning messages literature review

Chapter 2 focuses on literature from current standards and general design principles specifically for the design, emphasis, and placement of safety warning messages in owner's manuals.

Chapter 3: Methodology

The methodology chapter outlines the process I took to do research, find sample manuals for analysis, and draw final conclusions.

Chapter 4: Analysis of the safety warning message in owner's manuals

In Chapter 4 I analyze a set of current chainsaw owner's manuals to interpret safety warning message design and placement. Specifically I analyze the signal word and its own characteristics, the safety alert symbol, and the placement of the warnings in regard to task instruction.

Chapter 5: Creating design criteria

In Chapter 5 I draw conclusions from the analysis presented in Chapter 4 and present a set of design criteria for safety warning messages that will not only be applicable to owner's manuals, but also adaptable to a broad range of professional communication settings.

Chapter 2: Elements of safety warning messages literature review

Before developing a set of criteria for the design of safety warning messages, a review of current safety message design standards and general design principles will show what kinds of strategies are available for technical writers. The goals for this thesis are to determine what elements of design contribute to a set of safety warning message criteria (with major emphasis on the saliency of the message), and what kind of criteria can be developed to fit a broad number of professional communication settings; therefore, to investigate improving design criteria there are two specific concerns to be covered in the following literature review:

1. What standards currently exist for safety warning message design in technical manuals,
2. Which general design principles can best be adapted to the criteria developed for this study.

After an overview, I will synthesize and analyze of the specific principles and terminology drawn from both of the existing standards and general design principles to develop the design criteria for this study. To begin the literature review, I will outline research that deals with the necessity of salient safety warning.

Michael S. Wogalter, Vincent C. Conzola, and Tonya L. Smith-Jackson write that “noticeability” is a major requirement of an effective warning (221). Noticeability is the “extent to which the design of a warning will gain or attract attention against a field of competing visual stimuli” and to have this degree of noticeability, a message must be as salient as possible (221). *Saliency* means being prominent, or conspicuous, or standing out, and large bold print, high contrast, color, borders, and pictorial symbols are a few of the ways

Wogalter, Konzola, and Smith-Jackson recommend for increasing the salience of safety warning messages (221). The design criteria for safety warning messages that I intend to develop in this thesis must emphasize salience in owner's manuals because the safety of the users is at stake. *Salience* is a term I will use to refer to the visual enhancement of safety warning messages in order to capture the attention of the users.

Marc Green in the article "Why Warnings Fail" on the Occupational Health and Safety (OH&S) website describes the need for salient warnings. If a user fails to notice a warning, he or she will not consider the risk or even consider reading or complying with the warning, and while this thesis will not analyze the effectiveness of text in a message—a major research area in its own right—visual analysis of the presentation of the warning message will be conducted based on research and theory. The effectiveness of text in a message is not a part of this study because it is a research area of safety warning messages that has already received much attention in the past two decades.

In addition, this study will not conduct user testing because of the magnitude of study necessary to gather a representative sample, and because of time constraints. Future user testing of the standards developed in this thesis is strongly recommended.

The design analysis of safety warning messages in this thesis is limited to the literature review and manual analysis of the signal word, safety alert symbol, and signal word panel. Research from various sources, including from Wogalter, Konzola, and Smith-Jackson, Karen A. Schriver, and Charles Kostelnick, has shown that messages that are salient are more likely to attract the attention of users in a visually stimulating environment as they read and comply with the instructional tasks (Wogalter, Konzola, and Smith-Jackson 221). Visual rhetoric in this study includes everything from the text surrounding the safety warning

message in the owner's manual to the work environment in which the user operates and maintains the product.

Charles Kostelnick defines a method of visual language analysis that can be adapted to an analysis of the saliency of safety warning messages in owner's manuals. In "Supra-Textual Design: The Visual Rhetoric of Whole Documents," Kostelnick argues that the global structure of a document, including the visual divisions and hierarchy, is part of its supra-textual elements (24). He further outlines three areas of visual rhetoric that occur at the supra-textual level and which "work in concert—modifying, complementing, and constraining each other" (13): *textual*, which refers to major typographical cues; *spatial*, which refers to the size and shape of the page; and *graphic*, which refers to markers such as bars and boxes that signal major divisions in the document (12). These coding modes define the global boundaries and seams of a document (24-25). For example, major divisions in the textual element could be the use of a bold, large font to distinguish chapter headings, or even indentation in the first line of a paragraph (25). Hierarchy is shown through the use of headings and other graphic markers between text, such as lines and boxes or graphics (25). Kostelnick identifies parallelism as an important supra-textual element that promotes unification throughout a document, specifically with unified and consistently formatted information. For example, if safety warning messages are scattered throughout a document, parallelism in their design will help users recognize the importance as well as the intended meaning of the message. Kostelnick also identifies multiple stylistic functions of supra-textual design. One such stylistic function is engendering interest in the document from the user. The supra-textual design in the textual, spatial, and graphic modes engenders interest because of the text choices, size, and shape of the document, and addition of graphics for

further visual appeal (26). The textual, spatial, and graphic modes can also set the tone of the document by providing visual cues to the user; the “supra-textual presence creates an immediate voice for the document” (26). The tone created by the supra-textual presence is part of the initial rhetorical impression and accessibility of the document to the user and affects the credibility of the document in the eyes of the user (26). The supra-textual elements outlined by Kostelnick can be analyzed in safety warning messages once some of these elements such as text, graphics, and spatial cueing, are defined.

Wogalter, Conzola, and Smith-Jackson include information in their article on the design factors at the supra-textual level that affect the saliency of a visual warning. They determined that large, bold print; high contrast; color; borders; and pictorial symbols play a role in the visual rhetoric of general warning design (221). In addition, Karen A. Schriver indentifies the figure-ground principle as another design factor affecting the saliency of a visual warning. Since the figure of the figure-ground principle is perceived as being in front of the ground(Schriver 306), in the case of safety warning message design, this principle creates saliency by having the users “see” the warning first separated from the surrounding instructional text (the ground). More specifically, if the warning message is salient in terms of supra-textual level design (typography, symbols, borders, etc) it should become the figure and “stand out” from the rest of the page. Furthermore, Schriver argues that figure-ground relationships are a design benefit for document designers because these relationships are “likely to effect the order in which people read the text and graphics” and potentially give document designers one more design element in their repertoire to shift the users’ attention to various parts of the document (309).

A better understanding and analysis of these factors as they pertain to safety warning

messages in owner's manuals is possible with the aid of definitions of keywords used throughout this thesis as well as throughout the current existing design standards in owner's manuals.

Definitions of signal words, safety alert symbols, and their involvement in an owner's manual

One of the most prominent ways to signify a safety warning message in an owner's manual is the **signal word**, which, as the ANSI Z535.6-2006 report defines, is the word or words that designate the degree or level of hazard seriousness (5). These words are DANGER, WARNING, and CAUTION. According to the Telecommunications Industry Forum (TCIF) which gathered its safety warning guidelines from both the ANSI Z353.4 report and Occupational Health and Safety Administration (OHSA) 1910 report, their three signal words are defined functionally as follows:

DANGER: indicates a definite hazard likely resulting in death or serious injury (11).

WARNING: indicates a potential that could result in death or serious injury (11). TCIF cautions designers to not use this signal word for hazards that may affect only equipment, software, data, or service (11).

CAUTION: indicates a situation in which minor or moderate injury could occur because of the hazard present. TCIF indicates that ANSI also accepts the use of CAUTION for property-damage-only hazards while OSHA 1910.145 allows CAUTION to be used only for injury risks (6).

Wendy A. Rogers, Nina Lamson, and Gabriel K. Rousseau cite studies from many researchers, including Adams, Bochner, and Bilik, who repeat that study participants rate DANGER as a signal word more likely to draw attention than CAUTION (112).

Additionally, the International Standards Organization (ISO) also highlights the following words as acceptable for signal words: *Alert (Prohibitive)* which implies that the action must be avoided in order to protect property from damage, and *Alert (Imperative)* which implies that an action must be performed to prevent property damage (TCIF 12). All three standards and safety agencies allow the signal word *Safety* to designate general safety information, including reminders and precautions, or state additional policies (TCIF 12). Hans van der Meij and Mark Gellevij argue that while these words designate high and low levels of hazardous situations, users who may not be acquainted with these words may assemble them all under a general idea of alert, and consequently not heed the necessary level of safety or caution to avoid potential injury or death (10). While the wording of the actual warning message (such as the instruction to avoid injury or death) in the safety warning message is not as previously noted a factor that will be analyzed in this thesis, the use of a signal word for design emphasis will be included because of its visual impact. In “Research-Based Guidelines for Warning Design and Evaluation,” Wogalter, Conzola, and Smith-Jackson state that a signal word should be used to attract attention and “indicate the level of hazard present” (221) and that the presence of a signal word increases its effectiveness (221).

Other definitions necessary before the review of the published standards and general design principles are that of the *safety alert symbol* and *signal word panel*. The remaining definitions each play an important role, along with the signal word, in the overall design or safety warning messages in the attempt to establish saliency within an owner’s manual.

Safety alert symbol: the triangular-shaped symbol that encompasses an



exclamation mark. This symbol combines the common shape for alert,

the triangle, with a common punctuation mark used to reflect a strong point of

interest. Colored parts of this symbol also help illustrate its saliency and warning status.

Signal word panel: the area that combines and contains the signal



word and safety alert symbol. The safety warning word

message is not considered part of the signal word panel for ANSI but is part of the overall layout of the safety warning message. This thesis will maintain this definition because much of the literature review refers to this grouping of warning message elements with this terminology.

Word messages: the instruction written to help users



recognize, understand, and avoid the potential

harm or injury to which that specific safety warning message refers. This study will not examine the content or effectiveness of the word message, but will examine the visual role of the word message block as it pertains to the overall design of the safety warning messages, when pertinent.

The definitions provided here will aid in understanding how design of safety warning messages is presented in published standards and in the general design principles as detailed in this literature review. The current published standards will be examined to determine the design guidelines for the design of safety warning messages, and these ideas will be one of many factors to consider as the set of design criteria are developed for this thesis.

Current existing standards

Standards are a culmination of research and testing and are designed to be adaptable to a broad range of settings (ANSI Z535.6-20061-2). Standards mentioned in this literature

review include U.S. standards as well as those developed by the International Organization of Standardization. This first section will review national standards for the design of safety warning messages in product manuals and attempt to address which standards may be adaptable to the design criteria of this study. To begin, the American National Standards Institute (ANSI) publishes standards sets outlining how to best graphically present safety information (ANSI Z535.6-2006 1). In 2006, ANSI published a standard for safety information as displayed in product manuals, instructions, and other collateral materials (known as ANSI Z535.6-2006). The compilation of this standard set comes from the application of appropriate standards from the ANSI Z535.4 standard set, which recommends design information for safety signs and labels (ANSI Z535.6-2006 1). As a note of interest, the use of American National Standards is voluntary. Through the review of these recommendations and an analysis of owner's manuals, this thesis will look at the way these recommendations in practice actually affect the design of safety warning messages in owner's manuals. This review will look at the general information of the ANSI standards set, the standards of design for the signal panel, and the standards for the placement of the safety warning message in the manual. ANSI Z535.6-2006 has its own specific definitions in relation to the aforementioned typical elements of safety warning messages, and therefore this review will begin with the general information necessary to understanding the design choices.

The ANSI Z535.6-2006 standards set defines *safety messages* as word messages that inform users about the nature of the hazardous situation, consequences of not avoiding the situation, and/or method(s) for avoiding said situation (3). These safety messages fulfill the same purpose as the safety warning message as defined and used for this thesis. For further

definition, the safety messages are comprised of graphical components such as the signal word panel. According to ANSI Z535.6-2006, the signal word and the safety alert symbol construct the *signal word panel* (6). See Figure 2.1 for two examples of signal word panels.

The definitions from the elements that compose the safety warning message will enter in the review of the ANSI standards from this point on. The major warning message elements from the ANSI standards are the signal word panel (and signal word and safety alert symbol), and the warning word message. This section of the review of ANSI standards begins with the signal word and safety alert symbol and the effect of color on these components as well as the placement of the safety warning message within an owner's manual.

Adding color

Because the signal word designates the degree or level of hazard seriousness (ANSI Z535.6-2006 5), it is important that its saliency is produced through of the interaction of the typeface, size, and color. The following ANSI standards recommendations are to be used consistently in any setting where a safety message is used unless specified otherwise. Thus, these words, and their definitions and uses, will return throughout this review of current existing standards when illustrating the practical applications of the standards. The ANSI standards recommend the following typographical design choices for the *signal word*:

- The signal word shall be in a sans-serif typeface and in uppercase letters only (6).
- The signal word shall be a type size that is at least as large as the type size used in the warning word message. For example, the safety message text should be of a size that a person with normal vision (corrective vision included) can read under expected reading conditions and at a normal reading distance. Furthermore, the text size should also be no smaller than the majority of the surrounding text outside of the safety

message (6).

- The signal word can use a bold font such as Helvetica Bold or Folio Medium to increase saliency (6).

Adherence to these ANSI recommendations will help the typeface and font size combine to create a strong visual presence on the signal word panel. In addition, color is a design choice that also affects the visual saliency of a signal word in a signal word panel. Color affects each signal word differently when part of a



Figure 2.1 An example of an ANSI signal word panel as in reverse type (top) or non-reverse type (bottom).

signal word panel as reported in the ANSI standards set. According to ANSI Z535.6-2006, the colors in this standards set are drawn from the recommendations in the ANSI Z535.1-2006, the American National Standard for Safety Colors report. For the visual appearance of signal words, ANSI Z535.6 -2002 argues for the use of reverse type in an effort to increase the prominence of the warning message. The signal word panel is the combination of the signal word and the safety alert symbol. To design the panel, the signal word is centered on a contrasting rectangular background with the safety alert symbol preceding the word (6). This design can use reverse type by creating white text and safety alert symbol on a dark (black) background; or, if the background is the same color as the surrounding text and graphics, a contrasting background can be implemented (6) (see Figure 2.1). The ANSI Z535.6-2006 standard calls for the reverse of these signal words on background colors that are specific to the hazard level indicated by the signal word.

The colors for the signal words when part of a signal word panel are as follows:

- DANGER should be in white letters on the



background designated as the safety red color (8).

- WARNING should be in black letters on a background described as a safety orange color (8).
- CAUTION should be written in black letters on a color that corresponds with the safety yellow background (8).



The Telecommunications Industry Forum (TCIF) in the article “Admonishments (Safety-Related Warning Messages)” under the section “Recommendations for Design and Use of Admonishments” discuss the differences in ANSI and International Organization for Standardization (ISO) standards in terms of color use recommendations. While the standards mentioned are specifically for safety signs and labels on products, the overall safety message relayed through the standards is applicable to safety warning messages in owner’s manuals. ISO 3864, according to TCIF, uses the color yellow to indicate all levels of hazard while ANSI Z535.4 uses multiple colors (11). For example, ANSI uses yellow to signal only safety while red is designated for the most serious safety risks (11). TCIF has determined, in its opinion, that the ANSI use of red for the most serious warnings is confusing because that color already has two widely accepted uses: stop/prohibition and fire safety (11). Therefore, TCIF considers the ISO color coding of yellow for all hazards more practical because users will become acquainted with one unbiased color that signals hazard (11). TCIF also considers ANSI’s use of the black/orange color combination for WARNING messages to contribute to poor visual contrast and reduced readability (11). Furthermore, if color printing is not available, ANSI Z535.6-2006 deems it possible to use the same printing colors as the text and background colors used throughout the manual for the signal word panel. In these cases,

the signal word color should be in contrast to the color used for the signal word panel solid rectangle (ANSI Z535.6-2006 8). The second major element paired with the signal word in a signal word panel is the safety alert symbol. The safety alert symbol can have strong salience through the use of color and visual structural design.

The ***safety alert symbol***, according to the description provided by the ANSI Z535.6-2006 report, consists of an exclamation mark surrounded by an equilateral triangle and is used to indicate a hazard of potential personal injury (4).

There are two recommendations for color use of the symbol. The first recommendation states that the solid triangle portion of the symbol needs to be the same color



Figure 2.2 A colored safety alert symbol according to the signal word accompanying the symbol.

as the signal word lettering and the exclamation mark should be the same color as the signal word background (see Figure 2.2). Alternately, a black exclamation mark surrounding a yellow safety triangle which is furthermore outlined in black is acceptable

(8) (see Figure 2.3). An exception to these color combinations is if the safety alert symbol is used without a signal word, at which time, ANSI dictates, the triangle will be the same color as the word message text



Figure 2.3 Safety alert symbol as a yellow triangle and black exclamation mark.

and the exclamation mark will be the same color as the message background (8). In order to use the colors appropriately and effectively, the safety alert symbol needs to be designed on the signal word panel according to more ANSI standards.

On the signal word panel, the safety alert symbol, in relation to the signal word, needs to be horizontally level with the signal word and the height of the symbol should be equal to or greater than the height of the signal word letter height (7) (see Figure 2.4). The safety alert symbol must always accompany DANGER; however, when the message designates a

situation for either WARNING or CAUTION, the safety alert symbol is not required (15). Furthermore, it should not be used when indicating property damage.



Figure 2.4 Height and width relation of safety alert symbol to signal word (indicated by the yellow dotted line).

For all of these components to function to create salience within a manual, they must be part of a layout that is dependent upon the placement of this safety warning message within the owner's manual.

Designing safety warning messages

For ANSI standards, layout depends upon the type of safety warning message employed in the manual. There are three major safety messages that are specified by message and situation. The following review discusses each of the three and their specific design makeup. First, it is necessary to understand the role of the signal word panel in each type of message. The design of the signal word panel is constant throughout each type of safety warning message described in the ANSI standards set. To design the signal word panel, ANSI Z535.6-2006 specifies that, in traditional settings within the manual, the signal word should be centered on a contrasting rectangular background with the safety alert symbol preceding the word (6). This design can use reverse type by creating white text and symbol on a dark (black) background, or, if the background is the same color as the surrounding text and graphics, a contrasting background can be implemented (6). A concept initially in the ANSI Z535.4-2007 report for the use of safety warning message on product labels claims that there may be up to three separate panels present in a single panel arrangement (ANSI Z535.4-2007 2); and that specifically, these panels may contain multiple elements to make up the warning message: a signal word panel, the area that contains the signal word; a message

panel, consisting of the text word message of the warning; and/or a symbol panel, containing the safety symbol, which has a different representation and meaning from the safety alert symbol (ANSI Z535.4-2007 2-3). Panel arrangement, as stated in the ANSI Z535.4-2007 report, is either horizontal or vertical depending upon the needs of the space and placement on the label [or within the manual for the purpose of this study] (5, 10-12). Panel arrangement also consists of being separated into either two-panel or three-panel formats. Two-panel formats consist of one panel for each the signal word and the word message (see Figure 2.5).

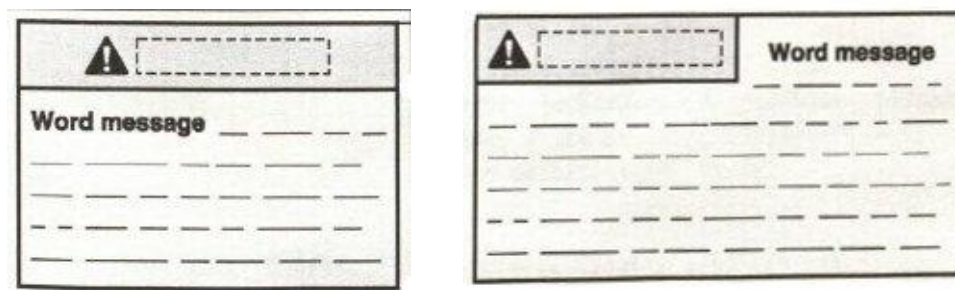


Figure 2.5 Examples of two-panel formats.

For three-panel formats, one panel consists of a signal word, another for the full word



Figure 2.6 An example of a three-panel format.

The actual size, layout, and proportion of the panel arrangement are dependent upon the requirements of the document, and consequently, creating a salient warning message within the manual is dependent upon attention to the panel arrangement. The next section of

message combination, and the third panel is the symbol and pictorial panel (22). See Figure 2.6.

the examination of current existing standards reviews how ANSI aligns the recommendations of the signal word panel with the three types of safety messages.

Grouped Safety Messages. Grouped safety messages, according to ANSI Z535.6-2006, are messages collected or grouped in a document or section of a document devoted primarily or exclusively to safety information (4) and should be located before any procedural information appropriate to the content of the message in manuals (12). Grouped safety messages allow users to access messages grouped by information (i.e., grouped by hazard type, or by severity of injury, or by the part of the product involved) (11). The signal word panel should be used if the signal word is used as a title or heading (12). The inclusion of safety alert symbols is dependent upon the use of safety symbols. Safety symbols are those that can exchange the word message involved and safety alert symbols should not, then to avoid unnecessary repetition, be used “in conjunction with each safety message in a group” (12).

Section Safety Messages. Section safety messages are messages that apply to entire sections or subsections, or cover multiple

paragraphs or procedures (4). (See Figures 2.7 and 2.8.) The section safety

message has multiple roles:

- precedes procedural information in a section and specifically provides safety information that is applied throughout a procedure;
- provides safety information for the section, not necessarily to any particular

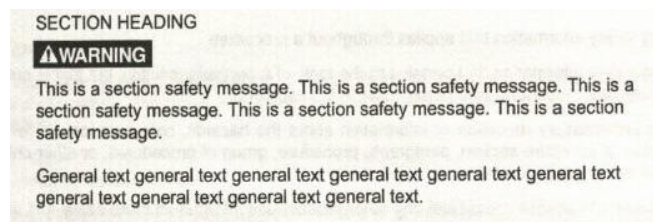


Figure 2.7 One example of a section safety message.

- procedural step in the section;
- reduces the unnecessary repetition of hazard, consequence, or avoidance

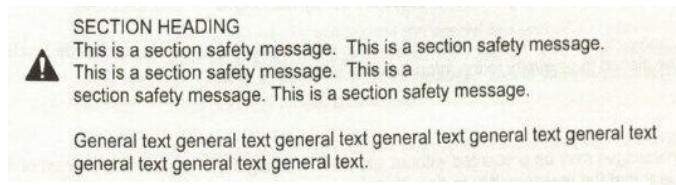


Figure 2.8 One example of a section safety message with only a safety alert symbol (no signal word).

- information as they apply to an entire section, individual or group of procedures or paragraphs;
- reduces the extent of safety message interruptions in the flow of information presented and allows users to more easily and efficiently retrieve safety information (13).

As for the placement of section safety messages, ANSI Z535.6-2006 concludes these messages should be placed at the beginning of a section, or at least before the information to which they apply (13). As for the layout of a section safety message, ANSI dictates that when a signal word panel is used, the signal word should be placed either above or to the left (beginning) of the safety word message. The signal word panel should be placed above or at the beginning (left side) of the message; however, if the safety alert symbol is used alone, it should appear to the left of the word message only (14-15) (see Figure 2.8).

Embedded Safety Messages. Embedded safety messages differ from the previous two because they apply to a specific part of a paragraph or section or a particular procedure and are

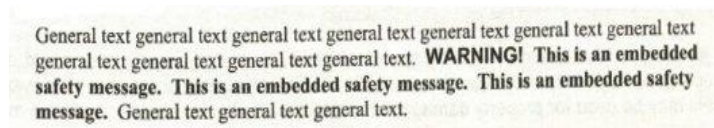


Figure 2.9 An example of an embedded safety message.

typically integrated throughout procedures (4) (see Figure 2.9). Specifically, as stated in ANSI Z535.6-2006, if used with procedures, the messages should be integrated so that users will avoid hazards as they come to them in the progression of steps (16). If the procedure is

non-linear, that is, if steps are expected to be skipped or performed in a different order depending on the situation, embedded safety messages should be placed where they are most likely to help users avoid harm (16). Embedded safety messages can also be placed in close proximity to the non-procedural information to which they apply. Non-procedural information includes explanatory or educational information (16).

Safety alert symbols, when included in section safety messages, have specific expectations in ANSI Z535.6-2006 standards set. These symbols may be used without the signal words WARNING or CAUTION and still effectively highlight the safety message. However, when the signal word DANGER is used, it must be accompanied by at least one safety alert symbol (18). But, if used alone, there are specific requirements for the appropriate use of the safety alert symbol: it should only appear to the left of the message, not above it (18). Moreover, safety alert symbols may not be placed before embedded safety messages that begin in the middle of a line of non-safety text (18).

The current existing standards for safety warning messages such as ANSI Z535.6-2006 play an important role in a technical writer's decision when designing these messages in owner's manuals. The standards, while remaining voluntary in their use, reflect research on and consideration given to the most appropriate use of typeface, color, symbols, layout, and placement for safety warning messages in these settings. These settings are illustrated the incorporation of three types of message—the grouped safety message, the section safety message, and the embedded safety message—and do not allow for alternate circumstances that create different settings for the use of safety warning messages in owner's manuals. For example, if borders are not used a warning message may become lost as an embedded message and consequently, users may fail to notice, read, and comply with the safety

directives. The next section of the literature review focuses on the current general design principles reported in recent research.

General design principles

This part of the literature review examines the general design principles presented in current scholarship and identifies which ones can be adapted for the safety warning message design criteria. My review begins with an introduction into the current thinking for creating salience and emphasis when designing documents and moves into characterizations of general design principles and their uses.

To capture the attention of users and increase the likelihood that they will read the warning, the warning design must not “put us off” as Karen A. Schriver states (164). She argues that attention to typographic and spatial patterns shows users what designers felt was important information and presentation (Schriver 250). Much research points to using design principles to increase the salience of safety warning messages in owner’s manuals. These specific principles involve typography, color, borders, and placement.

For this study, typography refers to the design of the signal word of the safety warning message because it is the only component of the message that is created from text (as the warning message text is not analyzed in this study). Since safety warning messages are one genre for one purpose, typography should be a simpler issue; however, researchers still differ on the best typographic choices for saliency and emphasis. Let us consider the typeface, letter style, and size.

Typeface choices

In *Dynamics in Document Design*, Karen A. Schriver writes that the outstanding features of sans-serif fonts are their strong uniformity in stroke width of the letterforms, that

is, their lack of “tails” that distinguish serif fonts. However, when mixing plain and bold text, sans-serif fonts hold contrast better and thus create stronger visual dimensions in a document (Schrivers 256-57). To draw upon each font’s forte, a mixture of serif and sans-serif faces is recommended by Schrivers for a single document to create salience, contrast, and hierarchy. Typically, serif fonts are used as the body text because of the strong ends on the letterforms, and sans-serif fonts, with their uniformed look, are used to design headers, captions, and marginalia (Schrivers 257). In addition, Wendy A. Rogers, Nina Lamson, and Gabriel K. Rousseau cite research observing that the readability of the signal word was linked to the type size. Specifically, readability declined when the type size was reduced in the experiment from 14 to 12 to 10 points (117). The intended audience is a factor when determining the appropriate type size; studies indicate that an older audience prefers larger type (117). Furthermore, a signal word in a type size differing by two points more than the main word text aids in creating salience and aids in the likelihood of reading the safety warning message (118).

Upper-and lowercase letter styles

In regard to signal words and letter style, Marc Green, in his article “Why Warnings Fail” argues that all capital text has poor legibility discouraging users from reading (2). Concurrently, Schrivers in *Dynamics in Document Design*, argues that reading speed is slowed when text is set in all capital letters and that a mixture of uppercase and lowercase letters is optimal for reading (274). However, neither author discusses how the typographic choice for a single word, such as a signal word, affects the users’ reading within a safety warning message.

Typeface treatments

Another factor of type style that can create contrast and salience in text is the use of bold or italic type. Michael S. Wogalter, Vincent C. Conzola, and Tonya L. Smith-Jackson in “Research-Based Guidelines for Warning Design and Evaluation” discuss the effects of typographical choices for warning labels; however, this information, because of the similar components (signal word) and harm or injury prevention message, can be transferred to safety warning messages in owner’s manuals. The authors state that bold type is preferred because of its evident contrast with most backgrounds, helping the words to stand out from the surrounding text (such as task instructions); however, the authors caution that the stroke width cannot be too wide for fear it will obscure the letter shapes (221). Likewise, Schriver states that bold lettering is preferred to uppercase letters when given the opportunity because of its clarity and contrasting values (274). Bold type also works well if it is used as reverse type.

Reverse type

Reverse type is another typographic treatment that researchers agree on as an effective tool to use to make the signal word in safety warning messages salient (see Figure 2.10). Schriver argues that the high contrast of white letters



Figure 2.10 An example of reverse type with a sans-serif typeface.

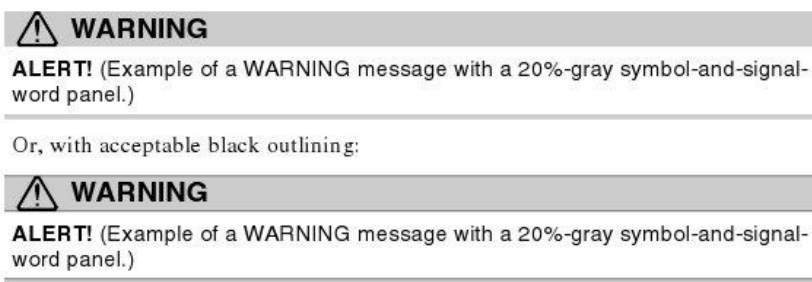
on black or colored background works as a strong visual cue to call attention to headers and other section designators (274). At the same time, she cautions that reverse type can impede the clarity of the message. When reversing type, typefaces need to be chosen for their strong strokes and cross strokes among other elements so that they do not look thinner than they are because of the dark background. For that reason, sans-serif fonts typically do not become lost

on a dark background (275). She also argues that a mixture of uppercase and lowercase letters in certain weights (medium or bold) is better for clarity in reverse type situations; however, her argument is geared toward situations of text lengthier than a single signal word (275). Pairing the specific colored background to the specific signal word increases the salience of the warning message.

Using color

Researchers have discussed the use of color in warning messages and, specifically, the use of color for signal word emphasis. Kline, et al., as cited in Wogalter, Conzola, and Smith-Jackson, recognize the positive effects of color use as “more salient and readable” and that messages with color are perceived as “being more hazardous than achromatic messages” (221). Kline, et al. specifically studied warning labels placed on products; however, their research can be transferred to the design of warning messages in owner’s manuals. Warning messages on product labels act in the same manner as warning messages in owner’s manuals; both want to emphasize the potential for hazard. Product label warning messages carry similar design concepts and goals for saliency. Furthermore, the research on warning messages on product labels is prevalent and highly regarded; therefore, the adaptability of this information to safety warning messages seems like a plausible option.

The Telecommunications Industry Forum (TCIF) advises its writers to use grayscale



or halftone printing when colored ink is not used. In these cases, TCIF asks for colors that normally would

Figure 2.11 Examples of safety warning messages in grayscale printing.

be in a colored ink to be either black, 20 percent gray or 60 percent gray, depending upon the signal word and original color (such as red or yellow) (17, 21). For TCIF, the colored background that the reverse type signal word is placed on is the major part of the signal word panel that can be adapted in grayscale colors (see Figure 2.11). Two-tone variation printing (black and white) is acceptable for TCIF documents if colored or grayscale printing is unavailable (Figure 2.12).

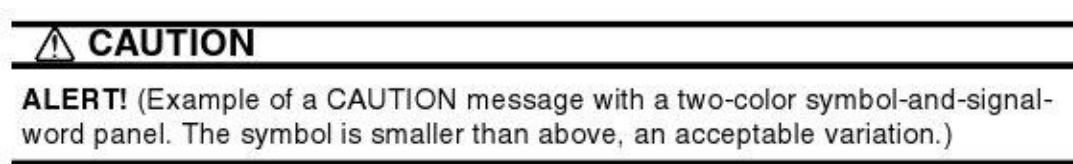


Figure 2.12 An example of a safety warning message in two-tone printing.

Color is not used solely to create salience in the reverse type of the signal word panel, as researchers have also examined the benefits of colored and thick borders outlining warning messages to create visual salience in owner's manuals.

Using borders

The layout TCIF uses in its alternate recommendations for two-tone variation printing includes thick borders that act to fence off the safety alert symbol and signal word from the message text (21-22). Wogalter, Conzola, and Smith-Jackson provide a rationale for including borders to increase salience in owner's manuals. They cite Wogalter and Rashid, stating that if thick, colorful borders are used, they are more likely to attract attention compared to similar messages that have thin or no borders (221). Colors and borders work to create salient safety warning messages in owner's manuals; however, this is just one part of the entire design that makes up visible warning messages.

Using symbols

Pictorial, symbol, image, or sign can all be used for the same meaning—a graphic representation of a message without the use of words (ANSI Z535.4 1991). Rudolf Arnheim states in *Visual Thinking* that a sign fulfills a function of an image. An image that is a sign stands for a “particular content without reflecting its characteristics visually” (136). In other words, a sign operates as a reference to the things for which it stands (137). An example of this comes from the 1926 international convention on road signs which

determined all traffic signs warning of danger should be a triangular shape (136). While the sharpness of the shape of the sign may evoke danger or awareness, this is not why the shape was chosen for its function. The shape is easily identifiable and distinguishable from other signs (136). As for



Figure 2.13 A recognizable and widely used sign for warning or a safety alert symbol.

safety warning messages in owner’s manuals, one specific sign has been adopted to be used in conjunction with warnings: the **safety alert symbol** (see Figure 2.13) or in other words the triangular shape surrounding an exclamation mark. The inclusion of images in safety warning messages increases their ethos as they are a recognizable sign of danger. As a result, users may be more apt to read a message with which they identify and which is plainly visible. Furthermore, Rogers, Lamson, and Rousseau cite Young and Wogalter who determined that recollection of the warning contents was increased when pictorials were used in combination with highly visible print (114). The authors concluded that the increased recollection of the warning was a result of the design factors that lead to the warning message being noticed in the first place (114). Of course safety alert symbols and signal words are not the only components of a safety warning message that need attention, the packaging of the message as a whole is important to creating visual salience.

Safety warning message layout

Layout is, as Wogalter, Conzola, and Smith-Jackson state, the internal characteristics of the warning message (222). These characteristics refer to the format, including typeface, and outlined text compared to continuous flowing text (222). The authors support text displayed in bullets or an outline form to continuous text because outlines are considered visually more appealing (222). It can be inferred that a major objective of designing the layout of the warning message is allowing for sufficient space around and between lines of text, signal words, and signal alert symbols.

Synthesis of current existing standards and general design principles

The final section of this literature review will act as a place where a synthesis and analysis of the specific principles and terminology drawn from both of the previous sections are developed into the design criteria for this study. To begin, some of the terminology will be transferred from the current existing standards section. Specifically, *signal word*, *signal word panel*, *safety alert symbol* will all retain their aforementioned definitions. These words and their definitions are readily accessible and understandable. The synthesis of the design principles will use these words and will, of course, focus on creating salient safety warning messages in owner's manuals.

Signal word and text choices

The signal words act as the first text-bound visual element on signal word panels, and therefore, would best benefit from highly visible design choices. A sans-serif font in all capital letters draws in theories from ANSI (ANSI Z535.6-2006) and Schriver (sans-serif is used for headers, and if used in all capital letters has a better chance at remaining clear and

visible compared to serif fonts). Two knowledgeable sources have decided this typeface with certain emphasis is an appropriate choice for saliency. Furthermore, bold typeface in conjunction with a reverse typeface setting (per Schriver and ANSI) will also increase saliency and be an additional benefit to a sans-serif typeface. Color is another important design choice that garnered lots of attention during the reviews of the current existing standards and the general design principles.

Signal word panel and color choices

Color will highlight signal words because of the use of reverse type and the construction of the signal word panel. According to Wogalter, Conzola, and Smith-Jackson, colors in design are “more salient and readable” (221) and, in terms of the signal words, can help to create visually emphasized text (see Figure 2.14). ANSI also recognizes the benefits of color use in signal words and their panels and has a specified set of color recommendations. Color can be considered an effective tool for increasing salience and the use of color should not be overlooked in owner’s manuals. However, not all owner’s manuals are printed with colored ink, and to balance this issue, ANSI determined recommendations for printing using surrounding text and background colors (e.g., black and white colors). While this remedies the issue of maintaining saliency for non-colored printing, it does not create a strong argument for the sole use of color. The situation I have in mind is the online publication of manuals. Many product companies are moving some or all of their access to manuals online, and this opens a new door to the use and effectiveness of color in manuals. Color can be used in an online format and not cost the amount that is required for printing color on paper. If companies



Figure 2.14 An example of a signal word with reverse type in color.

expect to publish manuals only online, it may be appropriate to consider an extended set of recommendations for the design of safety warning messages.

Signal word panel and borders

A recommendation for salience presented by scholars working with general design principles is the use of borders. An obvious use of borders in safety warning messages is around the entire message to offset it from the surrounding instruction body text. Many researchers argue for the use of borders, particularly borders in color or with thick lines, to create this distinction (Wogalter, Conzola, and Smith-Jackson) (see Figure 2.15).

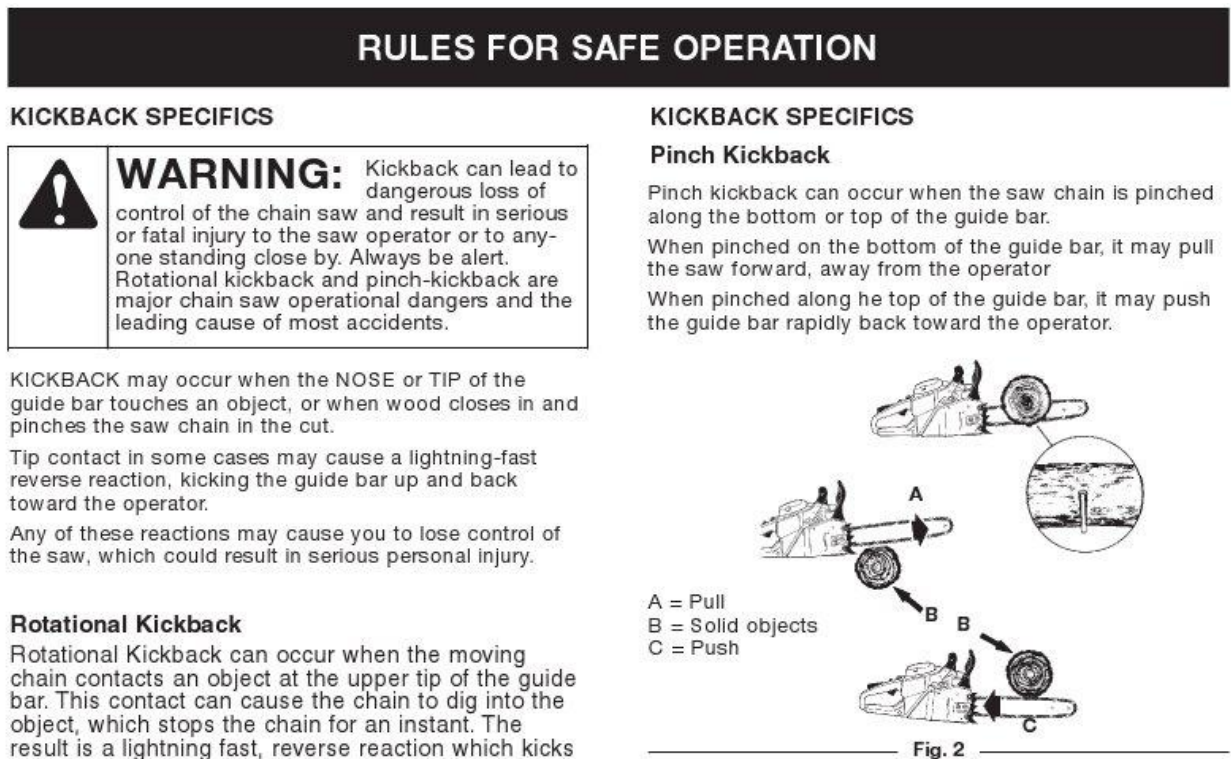


Figure 2.15 Part of a page from the Craftsman manual illustrating how the border enveloping the safety warning message creates salience from the surrounding instructional text.

ANSI Z535.6-2006, however, does not mention the use of borders in its recommendations.

This may be perhaps because the three major types of safety warning messages (grouped safety message, section safety message, and embedded safety message) do not allow for the

use of borders because of the very nature of the messages. Embedded safety messages, for example, are precisely as their name implies: they are embedded within the instructions' body text. Yet, the use of and benefits of borders should not be overlooked as they can create obvious distinction between the safety warning message and surrounding text, which, of course, is salience.

Signal word panel and layout and placement

The final design of safety warning messages is the overall layout of the message. Rogers, Lamson, and Rousseau cite studies which argue that the emphasis of visual characteristics of a safety warning message, such as the combination of visually enhancing use of color, symbols, and borders, creates a more salient presence than if only one or no element was used (115). The major analysis of layout comes from ANSI recommendations. The general layout of safety warning messages consists of the placement of the signal word panel with the word message. ANSI Z535.6-2006 offers layout options only according to the three major safety messages; however, the review of currently published owner's manuals shows that there are more situations in use than addressed by the three ANSI safety message designs. The next step in this study is an analysis of the placement of safety warning messages in owner's manuals.

Chapter 3: Methodology

I conducted this study in part because of my experience writing and editing technical manuals for an outdoor power equipment manufacturer. In addition to this knowledge, I wrote a graduate-level research paper on the visual rhetoric of safety warning messages in wood chipper/shredder owner's manuals. Each activity brought to light the inconsistency of safety warning message design in manuals.

I began to ask if a set of safety warning message design standards were to be developed based on current best practices in typography, layout, emphasis (color and borders), use of signal symbols, and placement within manuals, what would the major criteria be and how might they serve as a catalyst for new standards discussion?

Manuals for analysis

I my study conducted during early 2010. I chose the four sample manuals for this study because each provided at least one different safety warning message design element from the others while also showing similarities in design. I began by searching the internet for gas-powered chainsaw operation manuals. I chose manuals for chainsaws because chainsaws are a high-risk product, and consequently, there are on average 37 (34 in Craftsman, 20 in Echo, 61 in Makita, and 32 in Poulan) safety warning messages placed throughout the manuals. The manuals I chose for my list for analysis were determined by two factors. One, they were gas-powered chainsaw manuals for chainsaws of similar capacity. Two, the manuals were readily accessible in PDF or another downloadable form. I chose to search for and use manuals that were available by internet. The internet has recently played a new role in how users are able to receive manuals; it is not uncommon for companies to place manuals in a downloadable form on the internet for easy access by users. Uploading manuals to the internet provides users fast access for replacing

manuals that are lost or ruined. Ultimately, this study analyzed four owner's manuals—Craftsman, Poulan, Echo, and Makita. From my observation, it is likely the safety warning messages in each manual contain similar message content and that they could be found placed in roughly the same location within the instructions. These similarities help the analysis of design remain objective, increasing the likelihood that these manuals are representative of a safety-intensive genre of owner's manuals.

Literature analysis

Next I conducted a literature review of scholarly journals, published books, U.S. standards, U.S. safety websites, and private company safety recommendations (see Works Cited for the complete list of relevant literature reviewed). The majority of literature that I found focused on the design and written communication of safety warning messages on product labels. I adapted this information to suit warning messages in technical manuals because I felt the information was carefully gathered and encompassed all parts of warning message design on which I wanted to focus. In addition, I found that because the safety warning messages on product labels are similar in design, message wording, and performance to those in technical manuals, I could adapt the research on the former for the use on the latter. The following step was to determine from this literature what would help me build my list of safety warning message design criteria for analyzing the representative manuals and creating the final set of design criteria. I based this determination on the consensus of researchers and on my own knowledge from graduate coursework in this area. The final step was two-part, the first was to take the information from the literature review and analyze the representative sample of manuals for that information. The second was to determine what design criteria fit my research question

and develop my own set of design criteria that was adaptable to a broad range of professional communication settings.

Chapter 4: Analysis of the safety warning message in owner's manuals

The overall layout and placement of safety warning messages is important to their visibility, too. In this chapter, I analyze safety warning messages in four chainsaw owner's manuals, those manufactured by Craftsman, Echo, Poulan, and Makita. While the product itself and the content in the owner's manuals are similar, these safety warning messages take different approaches to designing salience and emphasis. Comparing the use of design criteria is the first step toward developing a specialized set of safety warning message criteria. After a rhetorical analysis, I describe the major criteria for creating salience in safety warning messages.

The following features increase the salience of safety warning messages in the owner's manuals analyzed:

- the typographical features of the signal word
- the use of colors
- the use of borders on the signal word panel, and
- the inclusion of symbols.

Analyzing the saliency

Many design elements influence how users' see and read safety warning messages. My preliminary analysis recognizes that the four manuals use notably differing design criteria. The design elements in the signal word, safety alert symbol, and the signal word panel of each safety warning message in each manual contribute to a unique user experience. For this analysis, I will break down the safety warning message into three components—the signal word, the safety alert symbol, and the signal word panel—and analyze the design of each. I will use the analysis to create the final set of design criteria.

Signal word

The signal word in a safety warning message acts as one of the first reminders of safety;

accordingly, it is conventional that each of the manuals under analysis uses signal words. This part of my analysis breaks down the design of the signal word. The text design creates salience in the signal word and each manual's safety warning message addresses the signal word in a similar way. In particular, the signal word typeface choice in all four designs is a sans-serif, all-capital letterform.



Figure 4.1 Craftsman signal word design.



Figure 4.2 Poulan signal word design.

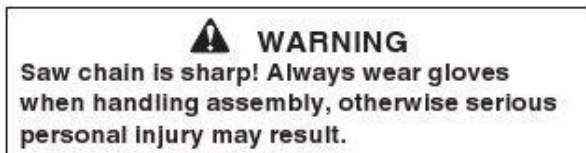


Figure 4.3 Echo Signal Word design.



Figure 4.4 Makita signal word design.

One common variable is the size of the signal word text in comparison to the surrounding message text. For example, Craftsman's signal word is nearly twice the size of the surrounding text (Figure 4.1). Poulan also uses a larger point size (Figure 4.2). Echo and Makita each use a signal word size equal to the size of the surrounding text (Figure 4.3 and 4.4 respectively).

Because it is the same size as the surrounding text and blends in, the signal word in the Echo and Makita manuals does not create the salience that a larger relative size does. Each manual uses at least one other feature to add salience to the warning message. As for color, three of out the four manuals (Craftsman, Echo, and Poulan) use black text on a white background for salience with the signal word. The exception is the Makita safety warning message, which displays the black signal word on a light gray background for a WARNING safety message (see Figure 4.4 on previous page). None of the manuals use a reverse text design to increase salience.

Furthermore, none of the signal word designs use colors such as red or yellow to draw attention to their presence.

Safety alert symbol

Safety alert symbols are a major part of the salience of a design because of their association as a message of warning. In three out of the four manuals analyzed (Poulan, Echo, and Craftsman), the safety warning messages contain one safety alert symbol, the only symbol associated with warning messages. The safety alert symbol looks the same in each safety warning message analyzed: the traditional white exclamation mark enclosed by a solid black triangle. That being said, the size and placement of the safety alert symbol in the safety warning messages differ.



Figure 4.5 Poulan safety alert symbol design



Figure 4.6 Echo safety alert symbol design



Figure 4.7 Craftsman safety alert symbol design

The safety alert symbol in the Poulan and Echo safety warning messages is not quite twice the height of the

letterforms for the signal word (see Figures 4.5 and 4.6). The safety alert symbol in the Craftsman manual, however, is set off differently than the other two examples. The positioning and sizing of the safety alert symbol in relation to the signal word brings us to the analysis of the signal word panel in the next section of this chapter (see Figure 4.7).

Signal word panel design

The position of the safety alert symbol helps attract attention to the signal word and, consequently to the warning message itself. In the three manuals that contain the safety alert

symbol, it is placed at the left of the signal word. While this is the same for each of the manuals, the overall layout of the signal word panel (which again is the combination and relation of the signal word and safety alert symbol) is different among the three manuals.

There are two conditions that seem to affect the layout of the signal word panel: signal word point size and safety alert symbol size. For example, Poulan and Echo are similar in terms of the comparative size of the signal word; however, the orientation of the signal word and safety alert symbol (Echo only) to the word message varies. To begin, the Poulan warning message uses a run-on signal word header with a colon separating that from the word message (Figure 4.8). In addition, this safety warning message uses more of an embedded message approach,

CAUTION: Never use straight gasoline in your unit. This will cause permanent engine damage and void the limited warranty.

where the warning message is not separated by a border or individual heading from the task instructions. A strength in this setup is the space saved in the text by not separating the header from the word message. Yet, unlike Echo or Craftsman or even a Poulan WARNING message, there is no safety alert symbol used in the Poulan CAUTION.

Figure 4.8 Poulan signal word panel



Figure 4.9 Poulan manual example of a signal word panel and the more salient Helpful Tip box.

In another example from Poulan, a light gray box is used to highlight not the safety warning message but a Helpful Tip (Figure 4.9). Therefore, when looking at a page from the Poulan manual, users will not notice the safety warning message with its embedded message and run-on header layout because it blends into the surrounding text, but will notice the Helpful Tip message because it is in a light gray background box with a border and features a large, subject-appropriate icon (such as the wrench in Figure 4.9) and large

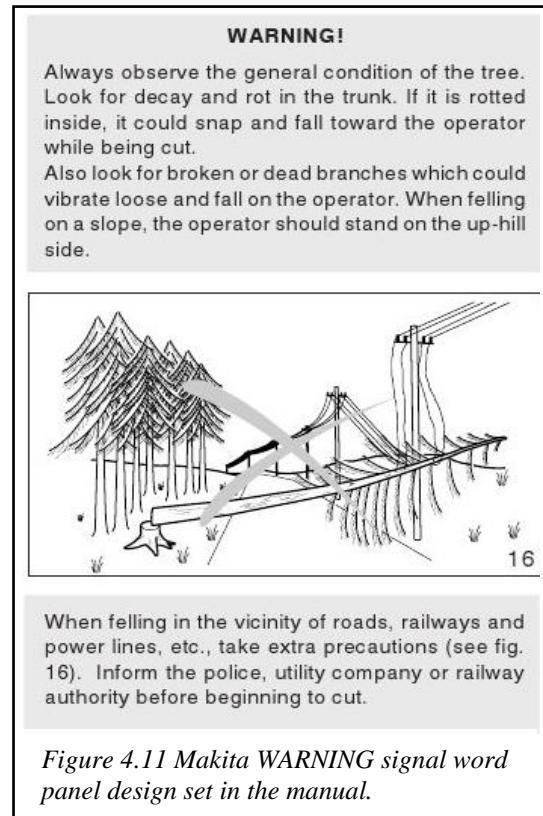
text size (see Appendix D for a full sample page from the Poulan manual).

The Echo safety warning message layout, in contrast, uses a header that creates visual prominence with the inclusion of the safety alert symbol (Figure 4.10). The safety alert symbol and the signal word are visually separated from the word message when they are centered on a line above the word message.

The Makita manual has a signal word and exclamation centered on a line above the word message similar to Echo, but the background on which the signal word panel sits differs from that in the other manuals (Figure 4.11). Salience is created because the signal word panel sits on a light gray background, thus standing out from the white background of the page (see Appendix C for a full page example of the Makita manual). However, this salience extends only to WARNING messages; CAUTION messages are only in bold font and are not as visually salient on a page in the manual as WARNING messages (Figure 4.12).



Figure 4.10 Echo, Inc. signal word panel design.



CAUTION:

This saw is powered by mineral-oil products (gasoline (petrol) and oil).

Be especially careful when handling gasoline (petrol).

Avoid all flame or fire. Do not smoke (explosion hazard).

Fuel mixture

The engine of the chainsaw is a high-efficiency two-stroke engine. It runs on a mixture of gasoline and two-stroke engine oil.

The engine is designed for unleaded regular gasoline with a min. octane value of 91 ROZ. In case no such fuel is available, you can use fuel with a higher octane value. This will not affect the engine.

Figure 4.12 Makita CAUTION signal word panel design as shown in the manual with instructional text below safety warning message.

As shown in Figure 4.13, the Craftsman manual employs a layout in which the prominent safety alert symbol is to the left of the signal word and word message.



Figure 4.13 Craftsman signal word panel design.

Each element that makes up the signal word panel in the Craftsman manual increases the salience of the warning

message. The contrasting font size between the signal word and the message text makes evident the nature of the message. Likewise, the large safety alert symbol in its location draws users' eyes to the warning.

Furthermore, a border is implemented in the Craftsman design and other manuals to increase salience. Both the Craftsman and Echo manuals use borders to separate the safety

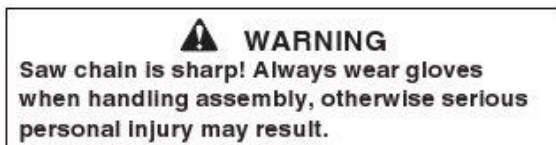


Figure 4.14 Illustration of the use of borders in the Echo, Inc. signal word panel.

warning message from surrounding task instruction (see Figure 4.14). In the Echo manual, the entire signal word panel and word message are made autonomous from the surrounding task

instruction by a thin, solid, black border (see Appendix B for examples of the salience borders create on a page from the Echo manual). The Craftsman manual employs a solid, black line border that surrounds the signal word panel and also interjects between the safety alert symbol and the signal word/word message combination. As a result, the width of the border line work acts to further distinguish the warning message from surrounding text. In both of these manuals, each page is set up in a two column format with task instructions and other messages in each column. Technical drawings and images are also contained within the column parameters. The width of the safety warning message border extends from the left column margin to the right

column margin, creating a vertical line on the left from the instruction task title and any numbered or bulleted task lists. See Figure 4.15 for an illustration of the two-column format from a Craftsman manual page (and Appendix A for more full-page examples taken from the Craftsman manual).

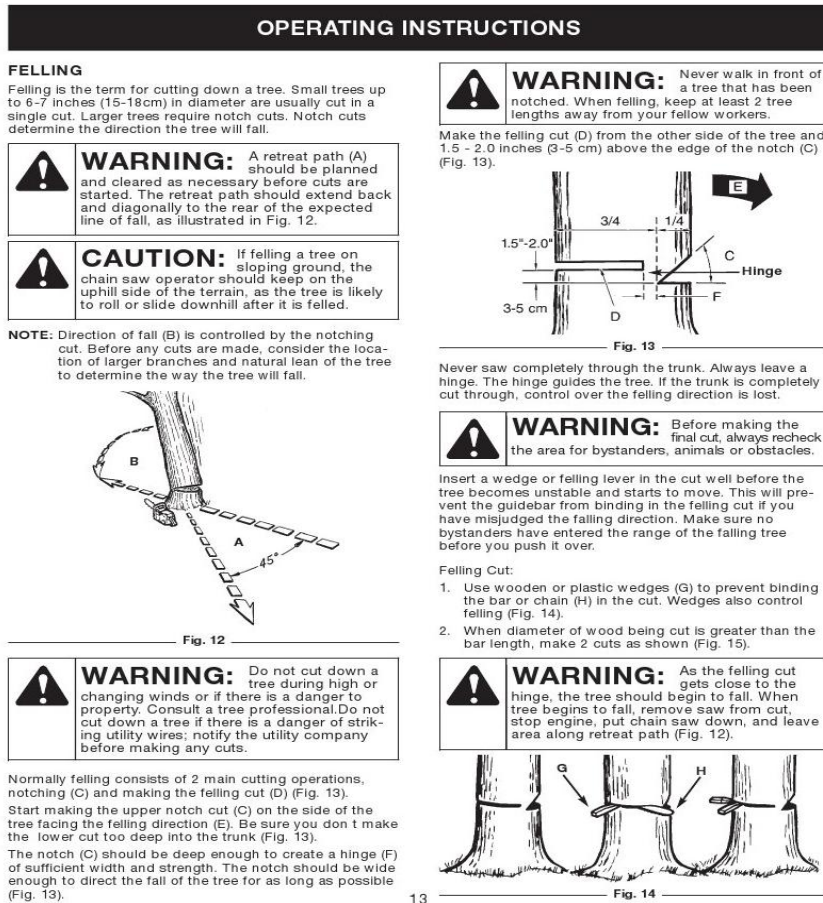


Figure 4.15 Signal word panels with borders in the Craftsman manual.

The four manuals analyzed employed many design choices for salience in the signal word, safety alert symbol, and signal word panel. Specifically, salience is most found in the borders used to separate the warning message from the surrounding task instructions, and at least in the Craftsman safety warning message, in the large signal word. These two

design choices help make the safety warning message prominent within the surrounding task instruction, which, of course, is the goal of a warning message. Some of the design choices draw from the ANSI recommendations and/or from general design principles. In order to develop a set of criteria for the design of safety warning messages that can be used in a broad range of communication settings, the next chapter will analyze the standards and general design ideas and

the four sample manuals.

Chapter 5: Creating design criteria

If a set of safety warning message design standards were to be developed based on current best practices in typography, layout, emphasis (color and borders), use of signal symbols, and placement within manuals, what would the major criteria be and how might they serve as a catalyst for new standards discussion?

The ANSI standards have beneficial design recommendations for the salience of safety warning messages. The general design principles outlined in my literature review likewise add to the conversation about appropriate design recommendations. The analysis of safety warning messages in representative chainsaw manuals demonstrates what design issues are currently in practice. Obviously the main objective of a safety warning message is to advise users on the potential for a likely hazard if particular precautions are not taken. Therefore, warning message salience is key to getting users' attention as they read and follow task instructions. In this chapter I will evaluate all three of these contributors—ANSI, general design principles, and analysis of current manuals—in an attempt to develop a set of criteria that can lead the way for future discussions on standards. A comprehensive bulleted list version of this set of criteria is available in Appendix E.

Signal word

The signal word is one of the first textual elements users come to when reading safety warning messages. It designates the degree of hazard projected in the warning message. The criteria developed for this thesis must be adaptable to a broad range of professional communication settings; therefore, the following bulleted standards are ones that make up the final set for safety warning message design. According to researchers such as Schriver and Wogalter, et al.:

- The use of a sans-serif typeface is widely conventional as the font type for the signal word, in part for the typeface's ability to adapt to various salience-enhancing font effects (such as bold or italic text).

WARNING

Figure 5.1 An example of a signal word designed using the criteria from this thesis.

- In addition, the typesize of the signal word should be larger than the surrounding text. The larger text is easier to read and creates a visual separation from the surrounding text.
- All-capital letters work to increase salience.
- The signal word can be further emphasized with bolded letters and/or reverse type. The use of one or both of these elements increases salience. In some situations, bolded words are already a large part of the text on the manual's page. As a result, reverse type with bolded words helps distinguish the safety warning message from any surrounding bolded text.

Color is another design element that has weight in the ANSI recommendations and general design recommendations. Color on the signal word is typical, and the color usually varies according to the hazard level indicated by the signal word. It is not analyzed according to those recommendations in the representative manual sample. This is because the chosen owner's manuals only present safety warning messages in black and white and some light gray.

- Color for the signal word should be consistent throughout the manual, and the colors should be chosen to represent the most typically recognized colors for the hazard level indicated. For instance, red can be used for DANGER, orange for WARNING, etc., with such color used consistently throughout the manual.

The following paragraphs explain my choices for signal word design criteria based on the literature review. A major design issue running through the three contributors (ANSI, general design principles, and the manual analysis) regarding the signal word is the use of a sans-serif typeface and all-capital letterforms. ANSI and the general design principles (Schriver) agree that a sans-serif typeface is appropriate because of its traditional use as a header font and because the letter shapes are clear and hold contrast. ANSI calls for the letters to be in all-capital but does not provide an explanation for this choice. The representative manuals use sans-serif and all-capital letterforms to design their signal words and draw attention to the warning message. These analyses lead me to determine that because warning messages aim for salience, signal words should be in a sans-serif, all-capital typeface. Yet, the signal word criteria do not end there; the size of the signal word and further textual emphasis are two additional major design factors.

The signal word font point size varies among the representative manuals. The Craftsman signal word has more salience simply because it gives the visual impression that it is much larger than any other the other text. The Craftsman signal word size follows general design principles that state smaller text size is not read as well. When the signal word text is the same size as the surrounding text, like it is in the other three manuals, the signal word blends into the text and there is nothing overtly attention grabbing.

Still, all ANSI recommends is only that the type size be at least as large as the type size used in the word message. In the end, the larger font size creates more visual impact for the signal word panel when viewed alone or as part of the entire page (see Appendix A for a representative page from a Craftsman manual).

Both ANSI and general design principles discuss the benefits of additional textual emphasis-creating options. Specifically, both approve of bolding the signal word to draw more

attention. The signal words in the analyzed manuals all use bolded letters to help distinguish them from the warning message. Bolded letters also help keep the letter forms clear when using reverse type. Reverse type is a textual emphasis recommended by ANSI and general design principles; however, none of the safety warning messages in the analyzed manuals use this option. That being said, both the Craftsman and Poulan manuals use reverse type for their section headers (see Appendix A and B). The salience created by the section header reverse type is appreciated as it is one more element that stands out on the page when glancing through the information.

Safety alert symbol

ANSI and general design principles have discussed the safety alert symbol as a useful part of the design because it creates salience and because of its role as a recognizable icon of warning. ANSI proposes many conditions for the use of the symbol. Specifically, these refer to the positioning of the symbol to the other safety warning message components. The three manuals in my study that use the safety alert symbol position it according to ANSI recommendations—to the left of the signal word. The following list is part of the study’s final set of design criteria:

- The safety alert symbol will be an equilateral triangle with an exclamation mark inside. The triangle will be either black or the color of the signal word panel, whichever is allowed by printing constraints. At least one symbol will be used, its



Figure 5.2 Example from Echo BearCat 6 Inch Chipper owner’s manual.

placement will be to the left of the signal word. The use of two symbols with one on either side of the signal word is

accepted but not recommended because the repetition is unnecessary (see Figure 5.2).

- The safety alert symbol will be at least equal in height to the signal word, if not



Figure 5.3 Example of a safety alert symbol nearly twice the size of the signal word text from the Poulan manual.

larger than the signal word. In the case of the latter, twice the size of the signal word is the maximum appropriate size (see Figure 5.3). The symbol will be used with signal words that express serious injury or death: DANGER, WARNING, and CAUTION.

Signal word panel layout

The criteria for the overall layout of the safety warning message are complex because of the wide range of professional communication settings to which these criteria may apply.

- Signal word panels should have the signal word and safety alert symbol. A pictorial symbol in the symbol panel is also acceptable as an addition but is not mandatory. Because some pictorials do not carry international meaning, the addition of such a symbol could misinform, not clarify the meaning of the warning and was not analyzed as part of this study.
- To remain consistent, signal word panels should be in either a two-or three-panel format throughout the manual. The choice of format is dependent upon the length of message and space available.
- The use of borders around the signal word panel and grayed out sections may increase a warning's salience. Therefore warning messages should have borders to separate them from surrounding task instructions. Gray sections are more optional but do draw attention to the warning by contrasting with the black and white of surrounding text and images.

- In addition, if color is not available (specifically for the signal word), grayscale or two-tone printing are acceptable as alternatives (Figures 2.11 and 2.12).

In the ANSI recommendations, the signal word panel layout is dependent upon three different situations. These situations reflect the type of safety warning message used. The **embedded message** integrates the warning message with the task instruction text, the **section message** places the warning message at the beginning of the section, and the **grouped message** groups many warning messages together in the same place in the manual. According to the ANSI recommendations, technical writers are limited to these three types of message layout because these three encompass all situations. I disagree with this limitation. Not all warning messages will fit into those three conditions, or at least not in the design ANSI has determined for them. Sometimes a warning message is necessary immediately before an instructional step instead of at the beginning of a section. Users may forget warnings by the time they are important in the instructional text if the warnings are read at the beginning of a section. The embedded message is integrated into non-safety information and is identified only by the signal word or a safety alert symbol (Figure 5.4). However, I do not consider this embedded form applicable to a safety

General text general text general text general text.
WARNING! This is an embedded safety message. This is an embedded safety message. This is an embedded safety message.
 General text general text general text.

Figure 5.4 An example of an embedded message from ANSI Z535.6-2006.

warning message like the ones identified in this thesis or a strategy that follows the criteria established in this thesis. I believe safety warning messages need to be visually separated from instructional text through salient signal words, safety alert symbols, and other design factors such as borders, and embedded message design contain limited sizing of those items or none at all. Embedded messages are applicable only to situations where space may not be available for a

more design-detailed message or for less serious warnings such as a Safety, Notice, or Alert message.

A section safety message contains information that applies to the entire section. Unfortunately, if the information in the message only appears once at the beginning of a section, users may not read the beginning warning information because they want to jump to the task instructions, or if they do read it, they may not remember the warning when the situation to which it applies arrives in the task instructions. Of course the warning can be used again in the manual where appropriate; however, users do not always take that repetition well. Therefore, the a safety warning message should be placed within the task instruction to which it applies or at the beginning of the task instruction to which it applies.

This set of criteria works to provide not only a more comprehensive collection of design elements for safety warning messages, but also more precise guidelines than those currently available as national standards or general design principles or current practice. A comprehensive bulleted list version of this set of criteria is available in Appendix E.

Future research into the implications of this set

Even with the limits of this study, the information gathered points toward interesting conclusions. However, because of these limits, several important discussions are open. These design standards can help create consistent safety warning messages that would help prevent injury or harm to users of the products. Such standards would also ensure ease of use for technical writers and ease of understanding for users. The literature supporting the study indicated that the design choices for my standards set are salient and work toward preventing user injury or harm. The next step is to conduct research to prove or disprove that this standards set actually lowers the risk of harm.

For future discussions, the biggest issue I found when analyzing the representative sample of manuals is the lack of design consistency. The manuals employ design techniques found in current existing standards or in general design practices; however, there does not seem to be a consistency in design from one manual to another, implying that technical writers are not pulling their design criteria from one source that they believe encompasses the many professional communication settings they will encounter. I focused on creating a set of safety warning message design criteria that includes practical design information for a broad range of professional communication settings written from current visual rhetoric research. Other researchers can update this set of criteria as needed when best practices in design change.

This set of criteria can also act as a catalyst for further research and discussion, especially when usability testing of this set happens. Usability testing is a logical next step to ensuring users recognize, read, and comply with the safety warning messages in the designs I have deemed part of my criteria set. Usability testing could include safety warning messages in a variety of technical manuals for a variety of products and using testing techniques such as eye tracking or think aloud processing to determine if and how users notice and read safety warning messages. These testing methods could also lead to a discussion on if users believe there are too many warnings in a manual and the effect the number of warning messages has on users noticing, reading, and complying with the directives.

Additional research that could have benefit for this area would be the following: (1) Why technical writers are not complying with the same set of standards. This could be completed through surveys and interviews. (2) The printing or publishing costs of owner's manuals and the effect those costs have on design choices. (3) International standards and how technical writers respond to those standards. In addition, analysis of manuals that follow international standards

could be conducted to understand if these manuals' safety warning message designs are more uniform from manual to manual (and with varying products).

Examining the discussions that fall beyond the limits of this thesis is one direction toward testing the set of safety warning design standards to ensure its adaptability to a broad range of professional communication settings, capturing the attention and compliance of users, and finally helping prevent injury or harm to users, thus coming full circle to the safety warning message's cardinal function.

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Appendix A: Craftsman manual

OPERATING INSTRUCTIONS

FELLING

Felling is the term for cutting down a tree. Small trees up to 6-7 inches (15-18cm) in diameter are usually cut in a single cut. Larger trees require notch cuts. Notch cuts determine the direction the tree will fall.



WARNING: A retreat path (A) and cleared as necessary before cuts are started. The retreat path should extend back and diagonally to the rear of the expected line of fall, as illustrated in Fig. 12.



CAUTION: If felling a tree on sloping ground, the chain saw operator should keep on the uphill side of the terrain, as the tree is likely to roll or slide downhill after it is felled.

NOTE: Direction of fall (B) is controlled by the notching cut. Before any cuts are made, consider the location of larger branches and natural lean of the tree to determine the way the tree will fall.

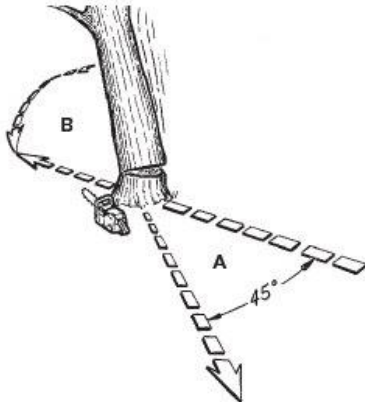


Fig. 12



WARNING: Do not cut down a tree during high or changing winds or if there is a danger to property. Consult a tree professional. Do not cut down a tree if there is a danger of striking utility wires; notify the utility company before making any cuts.

Normally felling consists of 2 main cutting operations, notching (C) and making the felling cut (D) (Fig. 13).

Start making the upper notch cut (C) on the side of the tree facing the felling direction (E). Be sure you don't make the lower cut too deep into the trunk (Fig. 13).

The notch (C) should be deep enough to create a hinge (F) of sufficient width and strength. The notch should be wide enough to direct the fall of the tree for as long as possible (Fig. 13).



WARNING: Never walk in front of a tree that has been notched. When felling, keep at least 2 tree lengths away from your fellow workers.

Make the felling cut (D) from the other side of the tree and 1.5 - 2.0 inches (3-5 cm) above the edge of the notch (C) (Fig. 13).

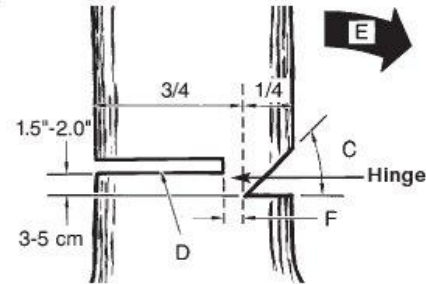


Fig. 13

Never saw completely through the trunk. Always leave a hinge. The hinge guides the tree. If the trunk is completely cut through, control over the felling direction is lost.



WARNING: Before making the final cut, always recheck the area for bystanders, animals or obstacles.

Insert a wedge or felling lever in the cut well before the tree becomes unstable and starts to move. This will prevent the guidebar from binding in the felling cut if you have misjudged the falling direction. Make sure no bystanders have entered the range of the falling tree before you push it over.

Felling Cut:

1. Use wooden or plastic wedges (G) to prevent binding the bar or chain (H) in the cut. Wedges also control felling (Fig. 14).
2. When diameter of wood being cut is greater than the bar length, make 2 cuts as shown (Fig. 15).



WARNING: As the felling cut gets close to the hinge, the tree should begin to fall. When tree begins to fall, remove saw from cut, stop engine, put chain saw down, and leave area along retreat path (Fig. 12).

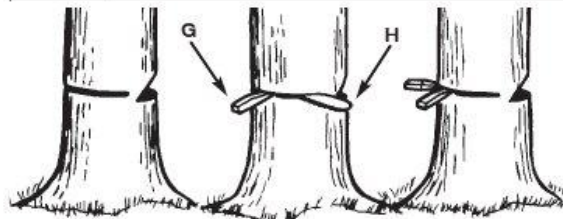


Fig. 14

A page from the Craftsman manual with a safety warning message within the task instructions.

MAINTENANCE AND REPAIR INSTRUCTIONS

OIL FILTER

NOTE: Drain oil reservoir before changing filter

1. Take the bottom plate off then use a wire with a hook (A) and pull oil filter (B) from reservoir. Remove old filter and replace.
2. Put filter and oil line back into oil reservoir so filter is at bottom of reservoir.

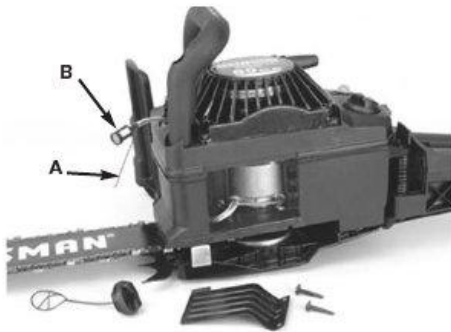


Fig. 33

SPARK ARRESTER SCREEN

NOTE: A clogged spark arrester screen will dramatically reduce engine performance.

1. To flatten the corners of the lock plate to be able to access the retaining nuts. Remove 2 muffler retaining nuts (E), Lock plate (F) and muffler cover (G) (Fig. 34).
2. Remove spark arrester screen (H) from the metal baffle (J). Replace screen with new one.
3. Reassemble the muffler components and tighten nuts securely.

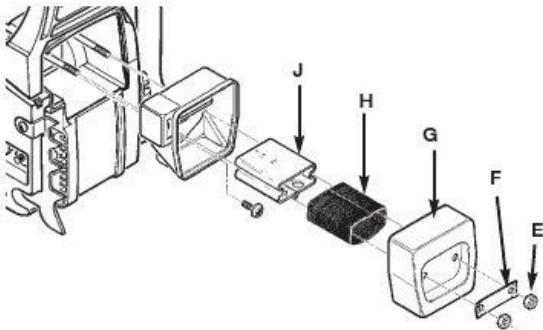


Fig. 34

SPARK PLUG

NOTE: For efficient operation of saw engine, spark plug must be kept clean and properly gapped.

1. Push STOP switch up.
2. Remove top Cover. Disconnect the wire connector from the spark plug by pulling and twisting at the same time (Fig. 35).
3. Remove spark plug with spark plug socket wrench. DO NOT USE ANY OTHER TOOL.



WARNING: Do not sand blast, scrape or clean electrodes. Grit in the engine could damage the cylinder.

4. Check electrode gaps with wire feeler gauge and set gaps to .025" (.635mm) if necessary.
5. Reinstall a new spark plug (champion RDJ8J or equivalent).

NOTE: A resistor spark plug must be used for replacement (part no. 9295-320001).

NOTE: This spark ignition system meets all requirements of the Canadian Interferen-Causing Equipment Regulations.

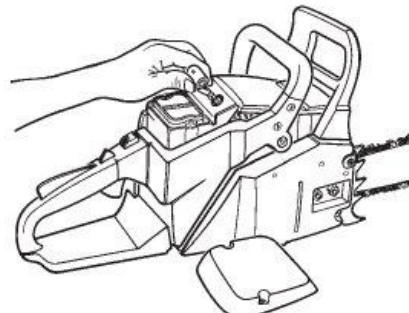
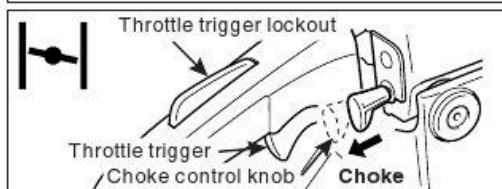
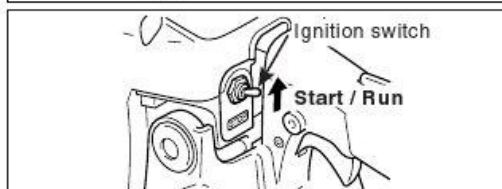
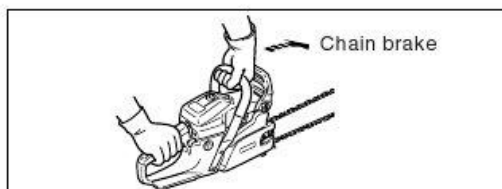


Fig. 35

CARBURETOR ADJUSTMENT

The carburetor was pre-set at the factory for optimum performance. If further adjustments are necessary, please take your unit to a Sears or other qualified service dealer.

Appendix B: Echo, Inc. manual



WHEN THE ENGINE IS COLD



CAUTION

Make sure the bar and chain are free from any obstruction when starting the chain saw.

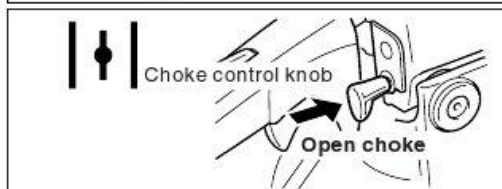
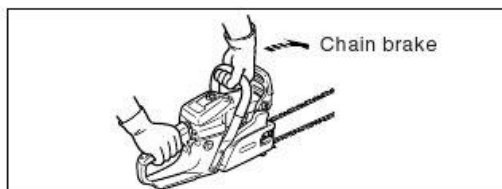
- Move chain brake lever fully forward to lock chain brake before starting.
- Fill the fuel tank with fuel mixture. It is not permitted to fill fuel above the shoulder level of fuel tank.
- Fill the chain oil tank with lubricant. Do not over fill.
- Move ignition switch to "RUN" position.
- Pull choke control knob all the way out. (Choke position)
- Securely hold the chain saw as shown and pull starter handle several times until first firing sound.
- Push choke control knob all the way in.
- Pull starter handle to start the engine.
- When engine starts, immediately squeeze throttle trigger, to release throttle latch, and pull front hand guard towards the operator immediately. (Chain brake unlocked position)

WHEN THE ENGINE IS WARM



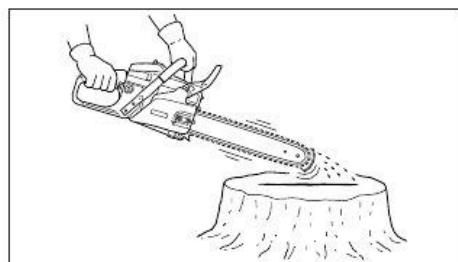
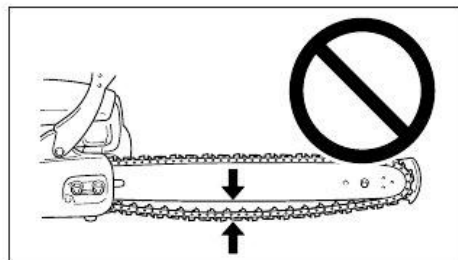
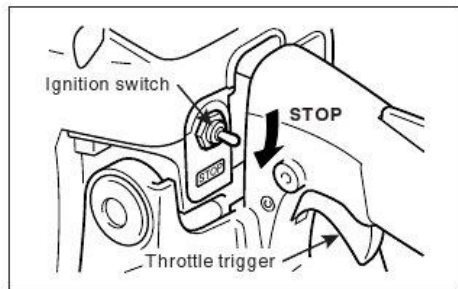
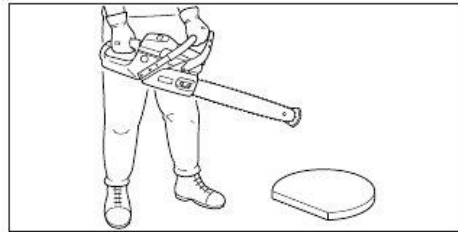
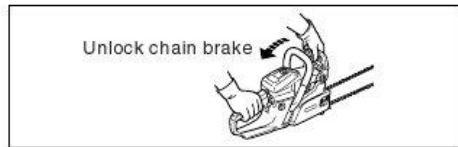
CAUTION

Make sure the bar and chain are free from any obstruction when starting the chain saw.



- Move chain brake lever fully forward to lock chain brake before starting.
- Confirm there is fuel and chain oil in the tanks.
- Move ignition switch to "RUN" position.
- Securely hold the chain saw as shown and pull starter handle.
- Choke may be used if necessary, but after first firing sound, pull throttle trigger to release choke.
- After starting the engine, pull front hand guard towards the operator immediately. (Chain brake unlocked position)

An example from the Echo, Inc., manual with a CAUTION warning and a NOTE message.



RUNNING

- When engine starts, keep idling for a few minutes.
- Set the brake lever in the unlocked position before starting to cut.
- Pull throttle trigger gradually and increase revolution of the engine.
- The chain starts running when the engine reaches 3800 r/min approximately.
- Confirm proper acceleration and lubrication of chain and bar.
- Do not run the engine at high speed unnecessarily.
- Be sure that saw chain stops moving when throttle trigger is released.

STOPPING

- Release throttle trigger and move ignition switch down to "STOP" position.

NOTE

If engine does not stop, pull choke control knob out fully to stop engine.

Return the unit to your authorized ECHO dealer to check and repair stop switch before starting the engine again.

CHECKING CHAIN TENSION

- Chain tension should be checked frequently during work and corrected as necessary.
- Tension the chain as tight as possible, but so it can still be pulled easily along the bar by hand.



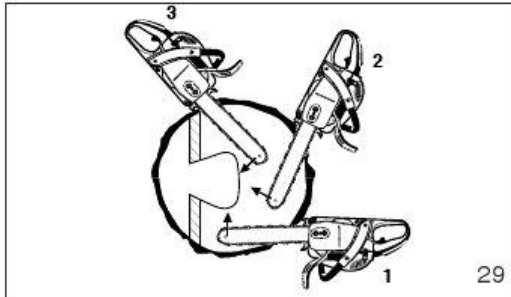
CAUTION
Do not operate with a loose chain.

CHAIN LUBRICATION TEST

Hold the chain just above a dry surface and open the throttle to half speed for 30 seconds.

A thin line of "thrown" oil should be seen on the dry surface.

Appendix C: Makita manual



WARNING!

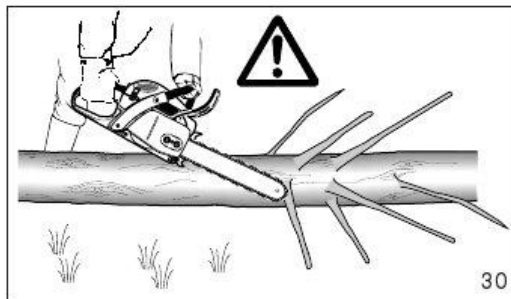
There is an extreme danger of kickback at this point. Extra caution must be taken to maintain control of the saw. To make the felling cut, follow the sectioning method described previously (fig. 29). If you are inexperienced with a chain saw plunge-cutting should not be attempted. Seek the help of a professional.

Limbing

Limbing is removing the branches from a fallen tree.

WARNING!

There is an extreme danger of kickback during the limbing operation. Do not work with the nose of the bar. Be extremely cautious and avoid contacting the log or other limbs with the nose of the guide bar. Do not stand on a log while limbing it - you may slip or the log may roll.



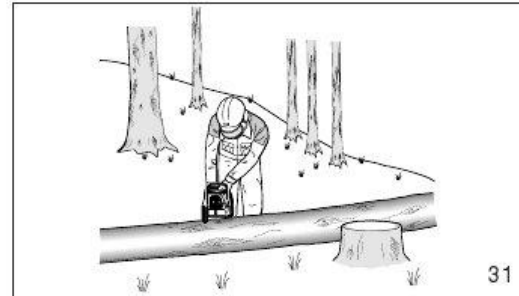
Start limbing by leaving the lower limbs to support the log off the ground (fig. 30). Always cut from the top of the limb. Do not underbuck freely hanging limbs. A pinch may result or the limb may fall, causing loss of control. If a pinch occurs, stop the engine and remove the saw, by lifting the limb.

WARNING!

Be extremely cautious when cutting limbs under tension. The limbs could spring back toward the operator and cause loss of control of the saw or injury to the operator.

Bucking

Bucking is cutting a log into sections.



WARNING!

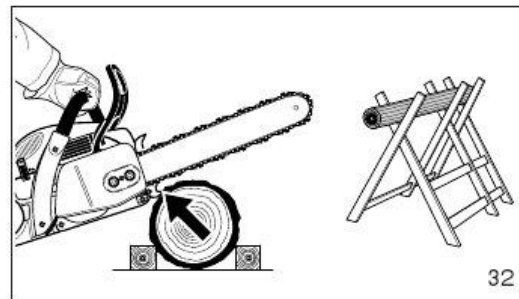
1. When bucking, do not stand on the log. Make sure the log will not roll down-hill. If on a slope, stand on the up-hill side of the log (see fig. 31). Watch out for rolling logs.

WARNING!

2. Cut only one log at a time.

WARNING!

3. Shattered wood should be cut very carefully. Sharp slivers of wood may be caught and flung in the direction of the operator of the saw.



WARNING!

4. When cutting small logs, use a sawhorse (fig. 32). Never permit another person to hold the log. Never hold the log with your leg or foot.

The Makita manual example with safety warning messages. Notice the warning messages lack the safety alert symbol or large font for the signal word; however, the technical illustrations are salient with borders and a large safety alert symbol.

Chain saw operating instructions

For assembly follow the procedure in the appropriate section "Mounting Guide Bar and Chain" of this manual. MAKITA chain, guide bar and sprocket must match each other (see the appropriate section in this manual).

WARNING!

Proper tension of the chain is extremely important. In order to avoid false setting the tensioning procedure must be followed as described in this manual. Always make sure the hexagonal nut(s) for the sprocket guard is (are) tightened securely after tensioning the chain. Check chain tension once more after having tightened the nuts and thereafter at regular intervals (always before starting to work). If the chain becomes loose while cutting, shut off the engine and then tighten. Never try to tighten the chain while the engine is running!

Fueling

Your MAKITA saw uses on oil-gasoline mixture for fuel (see chapter "Fuel" of this manual).



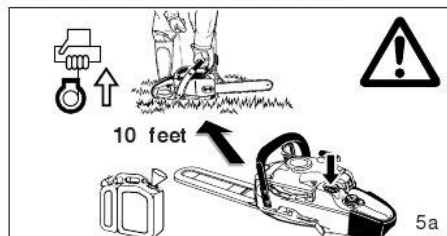
WARNING!

Gasoline is an extremely flammable fuel. Use extreme caution when handling gasoline or fuel mix. Do not smoke or bring any sparks or flame near the fuel (fig. 5).

Fueling instructions



Fuel your chain saw in well ventilated areas or outdoors. Always shut off the engine and allow it to cool before refueling. Select bare ground for fueling and move the chain saw at least 10 feet (3 m) from fueling spot before starting the engine (fig. 5a).

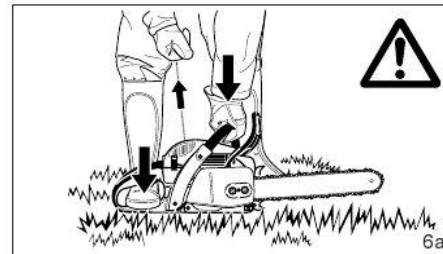
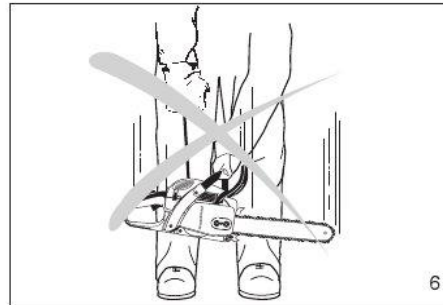


Wipe off any spilled fuel before starting your saw and check for leakage.

Check for fuel leakage while refueling and during operation. If fuel or oil leakage is found, do not start or run the engine until leak is fixed and spilled fuel has been wiped away. Clothing with fuel on it has to be changed immediately (this is a danger to your life!). Avoid skin contact with fuel. Never loosen or remove the cap of the fuel tank while the engine is running.

Starting

Do not drop start. This method is very dangerous because you may lose control of the saw (fig. 6).



Place the chain saw on firm ground or other solid surface in an open area. Maintain a good balance and secure footing. Place your right foot through the rear handle opening and firmly grasp the front handle with your left hand (fig. 6a).

Be absolutely sure that guide bar and chain are clear of you or all other obstructions and objects, including the ground, because when the engine starts in semi-throttle position, engine speed will be fast enough for the clutch to engage the sprocket and turn the chain which may cause a kickback.

Never attempt to start the saw when the guide bar is in a cut or kerf.

When you pull the starter grip, don't wrap the starter rope around your hands. Do not allow the grip to snap back, but guide the starter rope slowly back to permit the rope to rewind properly. Failure to follow this procedure may result in injury to hand or fingers and may damage the starter mechanism.

Appendix D: Poulan manual

THROTTLE LOCK-OUT

The THROTTLE LOCK-OUT must be pressed before you can squeeze the throttle trigger. This feature prevents you from accidentally squeezing the trigger.

CHOKE/FAST IDLE LEVER

The choke and fast idle are set by pulling the CHOKE/FAST IDLE LEVER out to the full extent for cold starting or after refueling. The choke provides additional fuel to the engine during cold starting.

PRIMER BULB

The PRIMER BULB circulates fuel to the carburetor to provide quicker starting.

CHAIN BRAKE

The chain brake is a device designed to stop the chain if kickback occurs. The chain brake

activates automatically in the event of kickback. The chain brake activates manually if the front hand guard is pushed forward. The chain brake is disengaged by pulling the front hand guard back toward the front handle as far as possible.

CHAIN TENSION

It is normal for a new chain to stretch during the first 15 minutes of operation. You should check your chain tension each time before you start the chain saw. See CHAIN TENSION under the ASSEMBLY section.

WARNING: If the saw is operated with a loose chain, the chain could jump off the guide bar and result in serious injury to the operator and/or damage the chain making it unusable.

BEFORE STARTING ENGINE

WARNING: Muffler is very hot during and after use. Do not touch the muffler or allow combustible material such as dry grass or fuel to do so.

WARNING: Be sure to read the fuel handling information in the safety rules section of this manual before you begin. If you do not understand the fuel handling information do not attempt to fuel your unit. Seek help from someone that does understand the information or call the customer assistance help line at 1-800-554-6723.

FUELING ENGINE

WARNING: Remove fuel cap slowly when refueling.



HELPFUL TIP

To obtain the correct oil mix ratio, pour 3.2 ounces of 2-cycle synthetic oil into one gallon of fresh gas.

This engine is certified to operate on unleaded gasoline. Before operation, gasoline must be mixed with a good quality synthetic 2-cycle air-cooled engine oil designed to be mixed at a ratio of 40:1. Poulan/WEED EATER brand synthetic oil is recommended. A 40:1 ratio is obtained by mixing 3.2 fluid ounces (95 ml) of oil with 1 gallon (4 liters) of unleaded gasoline. Included with this saw is a 3.2 ounce (95 ml) container of Poulan/WEED EATER brand synthetic oil. Pour the entire contents of this container into 1 gallon (4 liters) of gasoline to achieve the proper fuel mixture. DO NOT USE automotive or marine oil. These oils will cause engine damage. When mixing fuel follow the instructions printed on the container. Always read and follow the safety rules listed under HANDLE FUEL WITH CAUTION.

CAUTION: Never use straight gasoline in your unit. This will cause permanent engine damage and void the limited warranty.

FUEL REQUIREMENTS

This engine requires the use of minimum 87 octane (R+M)/2 clean gasoline.

IMPORTANT

Use of alcohol blended fuels (called gasohol or using ethanol or methanol) can cause major engine performance and durability problems.

WARNING: Alternative fuels (not gasoline) such as E-15 (15% alcohol), E-20 (20% alcohol), E-85 (85% alcohol) are NOT classified as gasoline and are NOT approved for use in 2-stroke gasoline engines. Use of alternative fuels will cause problems such as: improper clutch engagements, overheating, vapor lock, power loss, lubrication deficiency, deterioration of fuel lines, gaskets and internal carburetor components, etc. Alternative fuels cause high moisture absorption into the fuel/oil mixture leading to oil and fuel separation.

BAR AND CHAIN LUBRICATION

The bar and chain require continuous lubrication. Lubrication is provided by the automatic oiler system when the oil tank is kept filled. Lack of oil will quickly ruin the bar and chain. Too little oil will cause overheating shown by smoke coming from the chain and/or discoloration of the bar.

In freezing weather oil will thicken, making it necessary to thin bar and chain oil with a small amount (5 to 10%) of #1 Diesel Fuel or kerosene. Bar and chain oil must be free flowing for the oil system to pump enough oil for adequate lubrication.

Genuine Poulan bar and chain oil is recommended to protect your unit against excessive wear from heat and friction. Poulan oil resists high temperature thinning.

If Poulan bar and chain oil is not available, use a good grade SAE 30 oil.

- Never use waste oil for bar and chain lubrication.
- Always stop the engine before removing the oil cap.

CHAIN BRAKE

Ensure chain brake is disengaged by pulling the front hand guard back toward the front handle as far as possible. The chain brake must be disengaged before cutting with the saw.

Appendix E: The set of safety warning message design criteria

Signal word

- The use of a sans-serif typeface is widely conventional as the font type for the signal word, in part for the typeface's ability to adapt to various salience enhancing font effects.
- In addition, the typesize of the signal word should be larger than the surrounding text. The larger text is easier to read and creates a visual separation from the surrounding text.
- All-capital letters work to increase salience.
- The signal word can be further emphasized with bolded letters and/or reverse type. The use of one or both of these elements increases salience. In some situations, bolded words are already a large part of the text on the manual's page. As a result, reverse type with bolded words helps distinguish the safety warning message from any surrounding bolded text.
- Color for the signal word should be consistent throughout the manual, and the colors should be chosen to represent the most typically recognized colors for the hazard level indicated. For instance, red can be used for DANGER, orange for WARNING, etc., with such color used consistently throughout the manual.

Safety alert symbol

- The safety alert symbol will be an equilateral triangle with an exclamation mark inside. The triangle will be either black or the color of the signal word panel, whichever is allowed by printing constraints. At least one symbol will be used; its placement to the left of the signal word. The use of two symbols with one on

either side of the signal word is accepted but not recommended as the redundancy of the symbol's meaning is unnecessary.

- The safety alert symbol will be at least horizontally level in height with the signal word if not larger than the signal word. In the case of the latter, twice the size of the signal word is the maximum appropriate size. The symbol will be used with signal words that express serious injury or death: DANGER, WARNING, and CAUTION.

Signal word panel

- Signal word panels should have the signal word and safety alert symbol. A pictorial symbol in the symbol panel is also acceptable as an addition but is not mandatory. Its use is questioned because some pictorials do not carry international meaning and was not analyzed as part of this study.
- To remain consistent, signal word panels should be in either a two-or three-panel format throughout the manual. The choice of format is dependent upon the length of message and space available.
- Salience is gained with the use of borders around the signal word panel and grayed out sections. Therefore warning messages should have borders to separate them from surrounding task instructions. Gray sections are more optional but do draw attention to the warning by contrasting with the black and white of surrounding text and images.
- In addition, if color is not available (specifically for the signal word), grayscale or two-tone printing are acceptable as alternatives.

- Therefore, the placement of a safety warning message should be during the task instruction to which it applies or at the beginning of the task instruction to which it applies.